Coastal Engineering Technical Note

LEO
LITTORAL ENVIRONMENT OBSERVATIONS

By Leonette J. Thomas and William C. Seabergh

PURPOSE

The objective of this Coastal Engineering Technical Note is to describe the Littoral Environment Observation (LEO) measurement system and the tools available for District Offices to implement their own LEO data collection program. LEO provides low-cost coastal data for the planning, design, operation, and maintenance of coastal works.

LEO consists of systematic collection of wind, wave, and current data visually obtained by volunteer observers. LEO data are collected primarily at sites where little or no wave data exist, where resources are not available for installation of recording instruments, or where daily measurements such as beach width are desired. Over 360 LEO collection stations have been established on U.S. coasts. Data from previous LEO data collection efforts are available at each District office and some limited LEO data are available in the CEDARS database (reference CETN-I-23).

TYPES OF LITTORAL VARIABLES OBSERVED AND RECORDED

The LEO field measurements typically recorded are shown in Figures 1 and 2 (LEO recording form). Visual estimates are made of the wave period, breaker height, wave type, and width of surf zone. A protractor, shown in Figure 2, is used to estimate the direction from which the waves are approaching. The wind direction is noted on an 8-point compass. Windspeed is measured by a hand-held wind meter. A hand level is used to estimate the foreshore slope. The spacing of any observed rip currents (strong surface currents flowing seaward from the shore) and beach cusps (low mounds of sand separated by crescent-shaped troughs) are recorded. Littoral current speed and direction are measured by injecting dye and measuring its movement alongshore for a period of 1 min. The alongshore current can then be determined. The instruments mentioned earlier (wind meter and hand level) and environmentally safe dye can be obtained from sources noted prior to the references.

In addition, the observer may take sand samples of the material on the beach if this type of data is required and may also measure beach width. Remarks and comments by the observer regarding unusual beach weather or ocean conditions are recorded. LEO observations are usually taken once (or twice) a day, and sand samples are re-collected once a month.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
MAR 1997		**00-00-1997 to 00-00-1997**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Leo (Littoral Environment Observations)	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Engineer Waterways Experiment Station,Coastal Engineering Research Center,Vicksburg,MS,39180**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
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15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**8**	

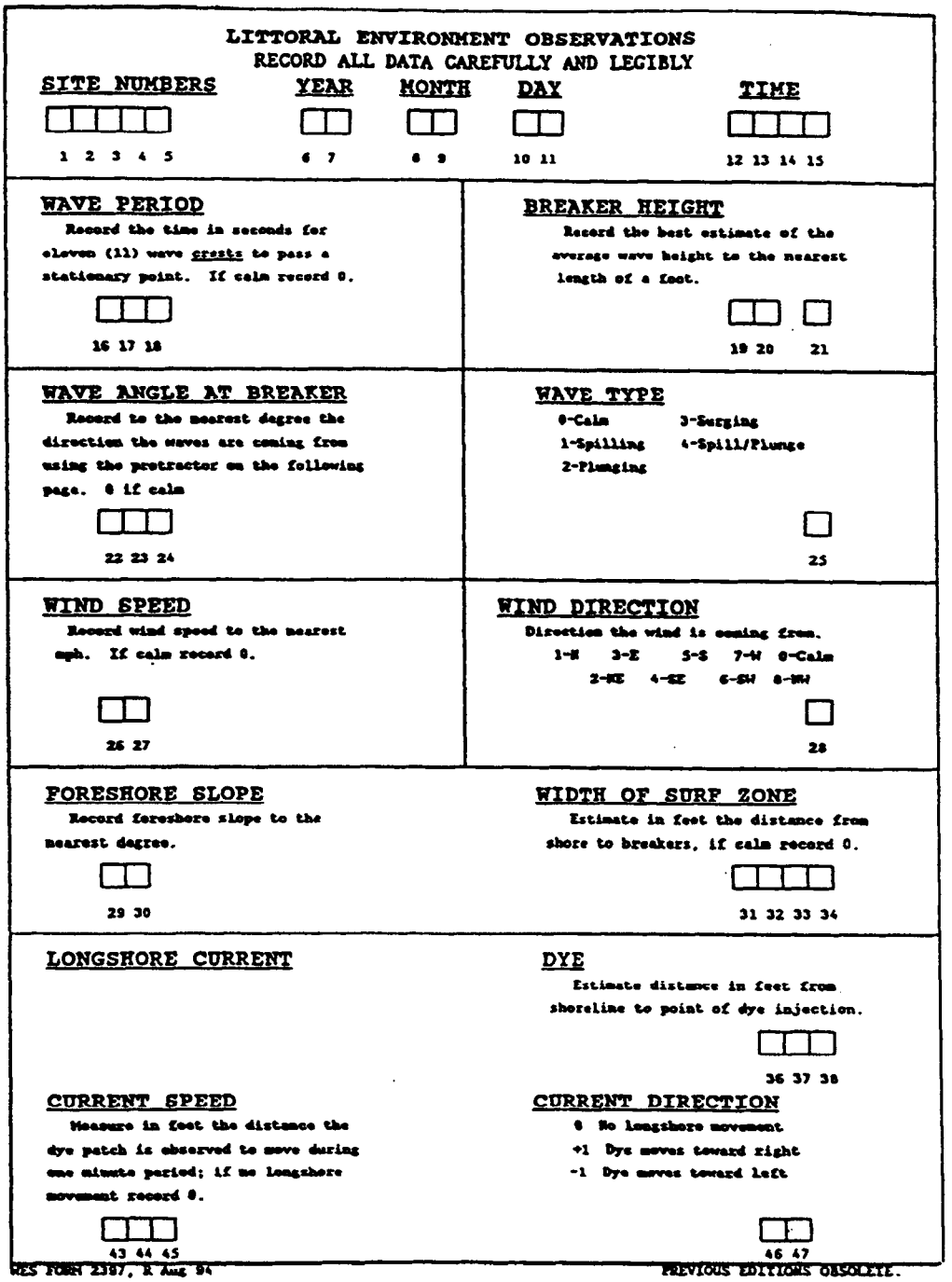


Figure 1. LEO Recording Form (front view)

RIP CURRENTS

If rip currents are present, indicate spacing (feet). If spacing is irregular estimate average spacing. If no rips record 0.

☐☐☐☐

49 50 51 52

BEACH CUSPS

If cusps are present, indicate spacing (feet). If spacing is irregular estimate average spacing. If no cusps record 0.

☐☐☐

54 55 56

BEACH WIDTH

Measure the distance of the most seaward Beach Berm crest from a reference point to the nearest foot.

☐☐☐☐

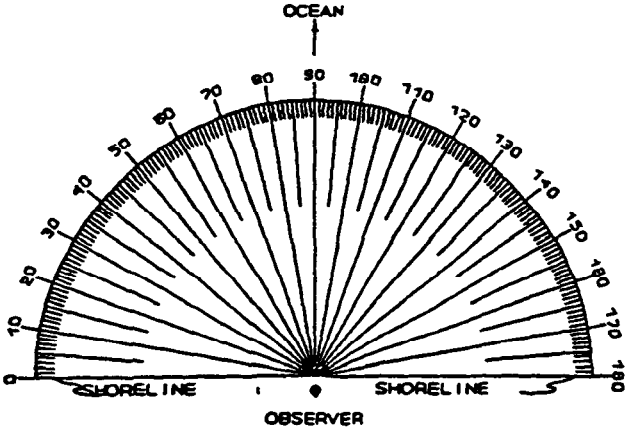
57 58 59 60

PLEASE PRINT:

SITE NAME _____ OBSERVER _____

Please Check The Form For Completeness

REMARKS: _____



NOTE: If a pier is used for an observation platform: place 0-180 line on the rail parallel to the centerline of the pier, sight along the crest of the breaking waves and record the angle observed

Figure 2. LEO Recording Form (back view)

Data collected from each site are compiled and summarized. Daily records are statistically summarized into monthly and yearly averages. This data can be useful in describing the beach environment at a particular site. Observer bias for high or low readings can be partially compensated for by looking at relative changes, rather than at the absolute values of certain parameters.

APPLICABILITY

The tabulated LEO data are useful for planning, design, operation, and maintenance of coastal facilities. While the data may not be as accurate as those obtained from recording sensors such as wave gauges and current meters, it is obtained at a relatively low cost. Because of this, it can often be obtained when instrumented information cannot. LEO data generally provide a wider suite of information than do an instrument station. LEO provides input for the following principal study items that can be used in solving coastal problems.

1. Geomorphology
2. Material characteristics
3. Winds and storms
4. Waves and currents
5. Ice conditions
6. Shoreline and offshore depth changes
7. Littoral transport (direction, amount, and character).
8. Effects of inlets.
9. Zoning considerations.

Comparison of the various beach material parameters for many beach locations should result in additional understanding of the geomorphology of a particular site, when correlated with all the other observed data. This can enhance the understanding of shore dynamics in relation to the materials composing the beach.

One of the several useful applications of LEO data is the prediction of longshore transport rates from waves breaking at an angle to the shoreline (item 7 above). These waves produce a longshore current, which, when coupled with the breaking wave turbulence, will suspend sediment and transport sand along the shore. LEO longshore current values allow computation of the longshore energy flux, which allows prediction of the longshore sand transport. Recent comparisons between two independent observers at a single LEO site suggest that more consistency exists for transport rates computed from their observations of longshore current velocity than from their observations of wave height and angle.

Compilations of the observed data on surf characteristics and beach response are also useful for studies directed primarily toward the recreational aspects of the shore. The ability to predict the overall characteristics of a beach for such uses as swimming and surfing will allow the appropriate agencies to assign various classifications of safety on use of the beaches.

DATA ANALYSIS

A program, Littoral Environment Observation (LEO) PC Data Retrieval and Analysis System, is available for PC on a 3.5 in. diskette along with the "User's Guide for the Littoral Environment Observation (LEO) PC Data Retrieval and Analysis System" (Thomas 1994). Both may be obtained from the local Corps of Engineers District, along with an instructional video showing how LEO data are obtained. A listing of LEO data sites where previous LEO data were collected is shown in Table 1.

The PC program can analyze the previous LEO data (Table 1) or new data, if they are contained in an ASCII text file with each line of data placed in the order as shown in the LEO recording form (Figures 1 and 2). The program can produce summary tables and percent occurrence tables of the measurements and also compute longshore sediment movement rates. See Thomas (1994) for further details.

SOURCES OF EQUIPMENT

Dwyer Handheld Windmeter, Stopwatch, Hand Level, Compass

Forestry Suppliers, Inc.
205 W. Rankin St.
P.O. Box 8397
Jackson, MS 39284-8397
Phone: 1-800-647-5368 Fax: 1-800-543-4203

- Dwyer Handheld Windmeter - Catalog No. 89001 - $14.25
- Digital Stopwatch - Catalog No. 92627 - $32.75
- Abney Level - Catalog No. 43922 - $65.90
- Compass - Catalog No. 37017 - $18.50

Powdered Dye (Uranine Concentrate Dye-yellow)

Tricon Colors, Inc.
16 Leliarts Lane
Elmwook Park, NJ 07407
Phone: 201-794-3800

- $10.70 per pound
- prepacked in 100 pound drum - repacking fee for smaller quantity

Slingshot, stopwatch, and compass can probably be purchased locally

Ideally the compass should have eight points identified, ie., N, NE, E, SE, SW, W and NW.

REFERENCE

Thomas, L.J. (1994). "User's guide for the littoral environment observation (LEO) PC data retrieval and analysis system," Instruction Report CERC-94-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

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DeWall, A.E. (1977). "Littoral environment observations and beach changes along the southwest Florida coast," Technical Paper 77-10, Coastal Engineering Research Center, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

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Sherlock, A.R., and Szuwalski, A. (1987). "A user's guide to the littoral environment observation retrieval system," Instruction Report CERC-87-3, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Shore protection manual. (1984). 4th ed., 2 Vol, U.S. Army Engineer Waterways Experiment Station, U.S. Government Printing Office, Washington, DC.

Smith, E.R., and Wagner, S.E. (1991). "Littoral environment observation program," *Journal of Coastal Research* 7(3), 595-605.

TABLE 1: LEO SITE LOCATIONS

SITE	LOCATION	ST
02001	KOTZEBUE WAY	AK
02002	SHORE LANE	AK
02006	NINILCHIK	AK
02007	HOMER SPIT	AK
02009	HOMER SPIT	AK
02015	HOMER SPIT	AK
02016	HOMER SPIT	AK
02022	HOMER SPIT	AK
02044	HOMER SPIT	AK
02054	HOMER SPIT	AK
05001	NEW BRIGHTON	CA
05002	THORNTON BEACH	CA
05003	FRANCIS BEACH	CA
05004	NATURAL BRIDGES	CA
05005	TWIN LAKES	CA
05006	SEA CLIFF	CA
05007	SUNSET BEACH	CA
05009	SAN SIMEON	CA
05012	PISMO BEACH	CA
05013	EL CAPITAN	CA
05014	CARPENTERIA	CA
05015	SAN BUENAVENTURA	CA
05017	LEO CARRILLO	CA
05018	BOLSA CHICA	CA
05019	PT. MUGU REC AREA	CA
05020	GOAT ROCK	CA
05021	WRIGHT'S BEACH	CA
05022	STINSON BEACH	CA
05023	MANCHESTER BEACH	CA
05024	VAN DAMME BEACH	CA
05025	RUSSIAN GULCH	CA
05026	MACKERRICHER	CA
05027	HUNTINGTON BEACH	CA
05028	DOHENY BEACH	CA
05029	SAN CLEMENTE	CA
05039	NORTH CARLSBAD	CA
05031	SOUTH CARLSBAD	CA
05033	SAN ELIJO	CA
05034	TORREY PINES	CA
05035	SILVER STRAND ST. PK.	CA
05036	PRAIRIE CREEK REDWOOD	CA
05037	LONG BEACH, 65TH PLACE	CA
05110	IMPERIAL BEACH SOUTH	CA
05120	IMPERIAL BEACH NORTH	CA
05140	DEL MAR	CA
05185	BUHNE POINT	CA
05300	NAVARRO	CA
05301	SHELTER COVE	CA
05302	CENTERVILLE BEACH	CA
05306	MAD RIVER	CA
05307	REDWOOD CREEK	CA
05310	PELICAN	CA
05313	ENDERTS BEACH	CA
05336	MISSION BEACH	CA
05355	DRAKE'S BEACH	CA
05367	CAPITOLA BEACH	CA
05401	VENTURA SITE 1	CA
05402	VENTURA SITE 2	CA
05403	VENTURA SITE 3	CA
05411	ARROYO BURRO ST. PK.	CA
05412	SHORELINE PARK	CA
05413	LEADBETTER BEACH	CA
05414	EAST BEACH	CA
05417	LOOKOUT PARK	CA
05419	HOLLY AVENUE	CA
05500	BOLINAS	CA
05501	FISHERMANS WHARF WEST	CA
05502	FISHERMANS WHARF EAST	CA
05503	FISHERMANS WHARF PIER	CA
05560	ALAMEDA	CA
05561	SYCAMORE	CA
05562	LINDA LANE	CA
05563	T STREET	CA
05564	CARDIFF FLATS	CA
05565	SOLONA BEACH	CA
05566	ORTEGA	CA
05567	TARAVAL	CA
05568	SLOAT	CA
05569	FULTON	CA
05570	IRVING	CA
05595	CASSIDY STREET	CA
05596	WITHERBY STREET	CA
05597	WISCONSIN TOWER	CA
05598	MUNICIPAL PIER	CA
05599	HARBOR BEACH	CA
05700	NEWPORT BEACH	CA
05701	OFFICER'S PIER	CA
05702	PEG NAVY (PT MUGU)	CA
05703	PEG PIER (CERC)	CA
05704	BALBOA BEACH	CA
05706	PEG 1000' SOUTH	CA
05707	PEG 1000' NORTH	CA
05712	SILVER STRAND NORTH	CA
05713	NET-SOUTH	CA
05714	MID-NET	CA
05715	NET-NORTH	CA
05720	MANDALAY BEACH	CA
05725	PIERPONT BAY	CA
05735	HOBSON BEACH	CA
05736	MUSSELL SHOALS	CA
05825	EAST BEACH	CA
05850	LEDBETTER	CA
05994	YELLOW ONE	CA
05995	SAN ONOFRE	CA
05996	OCEANSIDE	CA
05999	BORDERFIELD	CA
09001	SHERWOOD IS POINT	CA
09002	SHERWOOD IS WEST PT	CA
09003	COMPO COVE FENCE	CA
09004	COMPO COVE WEST	CA
09005	PROSPECT	CA
09006	PUMP STATION	CA
09007	SEAVIEW AVE	CA
09008	SOUTH STREET	CA
10100	PICKERING BEACH	DE
10101	KITTS HUMMOCK	DE
10102	BOWERS BEACH	DE
10103	SLAUGHTER BEACH	DE
10104	BROADKILL	DE
10105	LEWES	DE
10106	INDIAN RIVER INLET	DE
12000	PERDIDO KEYS	FL
12001	K.A. HANNAH	FL
12002	ATLANTIC BEACH	FL
12003	SOUTH LAKE WORTH IN.	FL
12040	SOUTH PALM BEACH	FL
12041	JUPITER	FL
12042	BOCA RATON	FL
12043	HOLLYWOOD	FL
12044	GOLDEN	FL
12054	MARINELAND STAD.	FL
12055	MARINELAND NORTH	FL
12056	MARINELAND QUALITY	FL
12057	MARINELAND SOUTH	FL
12060	HAULOVER	FL
12062	ALTOS DELMAR	FL
12063	SMATHERS BEACH	FL
12064	INDIAN BEACH PARK	FL
12066	LUMMUS PARK	FL
12067	JENSON 2 NORTH	FL
12068	JENSON 2 SOUTH	FL
12069	STUART 3 SOUTH	FL
12070	MONROE A	FL
12071	MONROE B	FL
12072	MONROE C	FL
12073	MONROE D	FL
12074	MONROE E	FL
12080	ANASTASIA REC. AREA	FL
12081	ST.AUGUSTINE	FL
12090	SANTAL ROASA ISLANDS	FL
12101	CRYSTAL	FL
12104	CAMP HELEN	FL
12105	ST. ANDREWS	FL
12110	GRAYTON	FL
12115	J.C. BEASLEY	FL
12118	NAVARRE	FL
12120	FT. PICKENS	FL
12895	REDINGTON SHORES	FL
12897	PANAMA CITY	FL
12898	BASIN BAYOU STATE PK	FL
12900	MEXICO BEACH, EAST	FL
12901	MEXICO BEACH, WEST	FL
13002	SAPELO IS. PROFILE #2	GA
13005	SAPELO IS. PROFILE #5	GA
13101	TYBEE LIGHTHOUSE	GA
13102	DESOTO MOTEL	GA
13103	POLICE STATION	GA
13107	NORTH BEACH	GA
13108	WANDERER	GA
13109	BUCCANEER	GA
13110	SOUTH WATER TOWER	GA
13111	EAST BEACH	GA
13112	COAST GUARD	GA
13113	KING AND PRINCE BEACH	GA
13114	ST. SIMONS SCHOOL	GA
15001	SUNSET BEACH	HI
15010	HANILEI	HI
15200	BELLOWS AFS	HI
15201	KUALOA	HI
15202	HILO BAY FRONT	HI
17050	SHERIDAN	IL
17090	ILLINOIS BEACH	IL
18020	CENTRAL	IN
18030	EAST PARK	IN
18040	STATE PARK	IN
18050	OGDEN	IN
22101	HOLLY BEACH	LA
22102	FONTAINE BLEAU	LA
23001	WILLARD BEACH	ME
26001	ASSATEAGUE	MD
26002	ASSATEAGUE NORTH	MD
26003	ASSATEAGUE SOUTH	MD
26005	OCEAN CITY, 52ND ST.	MD
26009	SMITH ISLAND	MD
26995	CHESAPEAKE	MD
26997	POTOMAC	MD
27004	LECOUNT HOLLOW	MA
27005	WASHBURN ISLAND	MA
27006	EEL POND	MA
27007	BRANT ROCK	MA
27008	NAUSET LIGHT	MA
28002	NEW BUFFALO	MI
28005	WARREN DUNES	MI
28010	VAN BUREN	MI
28020	GRAND HAVEN	MI
28025	HOFFMASTER	MI
28030	MUSKEGON	MI
28035	SILVER LAKE	MI
28040	MEARS	MI
28045	LUDINGTON	MI
28050	ORCHARD	MI
28055	BENZIE (PLATT RIVER)	MI
28060	D.H. DAY	MI
28065	CHARLEVOIX	MI
28280	WELLS	MI
28410	PORCUPINE	MI
28420	ONTONAGON	MI
28430	MCLAIN	MI
28450	MARQUETTE	MI
28470	MUSKALLONGE	MI
28480	TALQUAMENON	MI
28490	BRIMELY	MI

TABLE 1 (concluded) : LEO SITE LOCATIONS

SITE	LOCATION	ST
28630	HOEFT	MI
28640	HARRISVILLE	MI
28660	TAWAS	MI
28670	BAY CITY	MI
28675	SLEEPER	MI
28690	LAKEPORT	MI
28750	METRO	MI
28752	PORT SANILAC (SEC 11)	MI
28753	SANILAC (SEC 26)	MI
28850	STERLING	MI
30101	HORN ISLAND GULF	MS
30103	SHIP ISLAND GULF	MS
30104	SHIP ISLAND SOUND	MS
36001	MANASQUAN INLET	NJ
36755	OCEAN CITY	NJ
36989	CAPE MAY	NJ
38002	90TH ST. ROCKAWAY	NY
38004	JACOB RIIS PARK 2	NY
38005	JACOB RIIS PARK 4	NY
38006	OCEAN BEACH	NY
38007	WEST HAMPTON	NY
38008	EAST HAMPTON	NY
38009	29TH ST. ROCKAWAY	NY
38010	94TH ST. ROCKAWAY	NY
38011	145TH ST. ROCKAWAY	NY
38012	CATTARAUGUS CRK. SOTH.	NY
38013	CATTARAUGUS CRK. NOTH	NY
38014	CG STATION, 300FT EAST	NY
38015	GILGO UNDERPASS	NY
38016	WEST GILGO	NY
38017	PT. LOOKOUT STATION	NY
38018	COUNTY STATION	NY
38019	LIDO STATION	NY
39001	PEA ISLAND	NC
39010	SEA CREST	NC
39011	DUCK NORTH	NC
39012	DUCK PIER	NC
39013	DUCK SOUND	NC
39014	AVALON PIER	NC
39015	BOGUE SOUND	NC
39017	DUCK 1600 FEET	NC
39019	SOUTHERN SHORES	NC
39020	DUCK SOUTH	NC
39098	OCEAN ISLE BEACH	NC
39099	SUNSET BEACH	NC
39322	CAPE POINT	NC
39562	ATLANTIC BEACH	NC
41001	LAKESHORE PARK 1	OH
41002	LAKESHORE PARK 2	OH
41003	LAKESHORE PARK 3	OH
41004	LAKESHORE PARK 4	OH
41008	GENEVA ST. PARK	OH
41009	LINWOOD PARK	OH
41010	LAKEVIEW PARK	OH
41011	MAUMEE STATE PK	OH
41012	PRESQUE ISLE #9	OH
43001	FT. STEVENS	OR
43002	BARVIEW BEACH	OR
43003	SOUTH BEACH	OR
43004	NYE BEACH	OR
43005	UMPQUA SOUTH	OR
43006	HORSFAL BEACH	OR
43007	BASTENDORF	OR
43008	AGATE BEACH	OR
43009	HUBBARD CREEK	OR
43010	BAILEY BEACH SOUTH	OR
43011	AIRPORT BEACH	OR
43013	SPORT HAVEN	OR
43014	BAY OCEAN	OR
43015	BULLARDS	OR
43016	FACE ROCK	OR
43017	HACETA	OR
43018	GOOSE MARSH	OR
43019	UMPQUA NORTH	OR
43020	POINT ADAMS	OR
43021	ROCK DOCK	OR
44500	PRESQUE ISLE	PA
44501	PRESQUE ISLE #6	PA
44502	PRESQUE ISLE BCH 6	PA
48002	CHERRY GROVE BEACH	SC
48250	NORTH INLET	SC
48251	BULL ISLAND #1	SC
48252	BULL ISLAND #2	SC
48253	BULL ISLAND #3	SC
48254	HUNTINGTON BEACH	SC
48257	MURRELLS INLET	SC
48261	PORT ROYAL	SC
48262	GRASSLAWN	SC
48263	PALMETTO DUNES	SC
48264	NIGHT HAWK	SC
48265	HILTON HEAD INN	SC
48266	BAY BERRY	SC
48267	SOUTH BEACH	SC
48270	KINGFISHER PIER	SC
48271	SURFSIDE HOLIDAY INN	SC
48272	MARLIN QUAY	SC
48273	FOLLY BEACH	SC
48275	N. LITCHFIELD BEACH	SC
48276	LITCHFIELD BY THE SEA	SC
51001	PADRE ISLAND	TX
51002	PADRE SOUTH HOTEL	TX
51010	SEA RIM	TX
51240	BRYON BEACH	TX
51244	SEA ISLE	TX
51246	GALVESTON	TX
51248	BERMUDA	TX
51250	EAST BEACH	TX
51251	BOLIVAR	TX
51253	SWEDE'S	TX
51255	GILCHRIST	TX
51256	BEACH CITY	TX
51257	SHORE ACRES	TX
51600	CORPUS CHRISTI	TX
51601	CORPUS CHRISTI NORTH	TX
54004	BUCKROE BEACH	VA
54005	EAST OCEANVIEW	VA
54010	CENTRAL BEACH	VA
54011	CASTLEWOOD PARK	VA
57001	EDIS HOOK #1	WA
57002	EDIS HOOK #2	WA
57003	EDIS HOOK #3	WA
57004	EDIS HOOK #4	WA
57005	OAK HARBOR	WA
57006	SUNNYSIDE BEACH	WA
57007	SEAVIEW	WA
57008	HOLMAN	WA
57009	PEACOCK SPIT	WA
59010	ALFORD	WI
59011	APOSTLE ISLAND	WI
59012	ZIPPEL BAY	WI
59015	KENOSHA	WI
59030	GRANT	WI
59040	BRADFORD	WI
59070	HARRINGTON	WI
59080	KOHLER-ANDRAE	WI
59100	HIKA	WI
59120	POINT BEACH	WI
59140	PORT WING	WI